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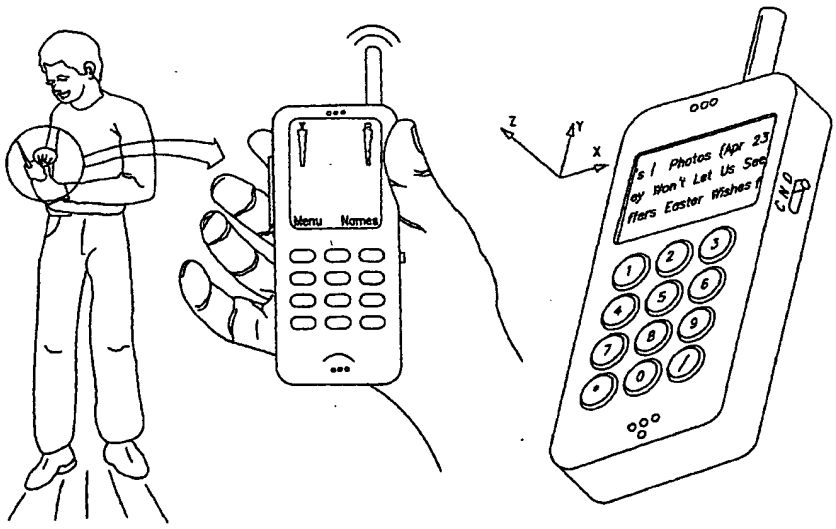
(54) Title: APPARATUS AND METHOD FOR THE KINEMATIC CONTROL OF HAND-HELD DEVICES



(57) Abstract: A portable hand-held device and method is presented for the kinematic control of hand-held, devices. including the control of their function, and the control of the information presented in the display of a portable device. The control is obtained by moving the entire hand-held device. The movement or the position of the device is sensed e.g. by accelerometers or a small camera mounted on the device. Specific movements are then used e.g. to turn the device on and off, to scroll the information presented in a device's display, or to zoom the image in or out.

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APPARATUS AND METHOD FOR THE KINEMATIC CONTROL OF HAND-HELD DEVICES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is directed to hand-held portable devices comprising at least one movement measuring means capable of controlling one or more functions of the device as well as controlling the presentation of information in the display of the device. The movement measure means sense the movement of the device or its position relative to another object. The invention also relates to a method for the kinematic control of a portable hand-held device by moving the device and measuring the movement of the device or its position relative to another object by movement measurement means. Advantageously, the invention provides a hand-held portable device and method for conveniently controlling the function of the hand-held device and the presentation of information in the display of the device.

2. Description of the Prior Art

Hand-held portable devices such as cellular phones, cellular radios, personal communicators, beepers, GPS units and others, are decreasing in size and becoming more versatile in function. For example, cellular telephones and personal communicators are used to transmit and receive data, documents, text, and pictures, to connect to the Internet, for e-commerce and other applications. At the same time, their small physical dimensions make it difficult to control their multiple functions using traditional approaches such as a keyboard. As used herein, the term "keyboard" refers here to any arrangement of buttons that can be pushed, joystick, touchpad and the like. This problem becomes more severe as the device dimensions shrink, for example when a cellular phone becomes as small as a wristwatch.

These devices usually have a small display, and it is often desired to use this display to present large amounts of information such as pictures or documents.

The traditional approach to the control of hand-held devices and the information presentation in their displays is to use specialized keys, e.g., for turning the device and various functions on or off, for selecting items from a menu, or for scrolling the information presented in the display. The traditional approach has several limitations: in a small device there may not be sufficient space for conveniently locating multiple keys, and the use of multiple keys may be confusing and difficult to remember.

It is therefore the object of the present invention to provide improved hand-held portable devices and a method for conveniently controlling the function of such devices and the presentation of information in their display. The new method improves upon existing methods by reducing the number of keys required to control the device and the information presented in its display, and by making the control simpler and easier to learn and to remember.

SUMMARY OF THE INVENTION

In accordance with the present invention, movement of a portable hand-held device is used to control various functions of the device and the information presented in its display. The term "hand-held" is used here to refer to any portable device that may be moved, translated or rotated, by the user during the operation of the device, including, for example, a device that may be worn as a wristwatch rather than held in hand during its operation. The invention also relates to hand-held remote control units that are used to control the function of other devices that are not by themselves portable, such as a TV set, video player or a DVD unit.

In accordance with the invention, the device is equipped with elements that measure the movement of the entire device (e.g. accelerometers) or its position relative to other objects (e.g. with a small camera mounted on the device). Specific movements are used, in addition to the possible use of control keys, to control different functions of the device. For example, lifting a cellular phone will activate it to respond to a calling signal, putting it back down will terminate the call. A small shaking movement of the device will turn it on if it is in the off state, and turn it off if it is in the on state.

Another example of the many advantages of the invention is selection from a menu. In the traditional approach, a menu presents a number of alternative functions to choose from, and the selection of an option from the menu is performed by operating a keyboard, for example by pressing buttons, or moving a cursor to a desired position in the display. According to the present invention, the selection of items from a menu can be obtained by moving the entire portable device in a particular direction. For example, two options to select from may be presented in the display, one on the left side of the display and the second on the right side. A movement of the device to the left will select the first option, and movement to the right will select the second option.

Movements can also be used to control the presentation of information in the display. For example, the display may show a small portion of a document. The document may contain text, pictures, graphics and will typically be too large to be presented all at once within the display of the hand-held device. Movements of the device in space will change the displayed information to show different portions of the document. If the device

is moved to the right, for example, then the displayed information will be changed accordingly, showing a new portion of the document to the right of the previously presented location. Moving the device closer or further from the user, or in a perpendicular direction to the display, will zoom the image in and out, changing the resolution of the presented image or the size of the displayed text or picture.

BRIEF DESCIRPTION OF THE DRAWINGS

For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows a schematic diagram of a hand-held device in accordance with the invention.

Figures 2 to 4 illustrate the kinematic control of a hand-held device in accordance with the invention.

Figure 5 illustrates an enabling means to avoid accidental activation of the hand-held device.

Figure 6 shows a schematic block diagram illustrating an embodiment of practicing the invention.

DESCRIPTION OF THE INVENTION

The hand-held device of the invention is equipped with elements for measuring the movements of the entire device, e.g. by three accelerometers that measure the acceleration along three independent directions. Alternative, or in addition, the position of the device relative to other objects can be measured, e.g. by using a small camera mounted on the device. Such a camera can take a sequence of pictures of static nearby objects, for example, a tabletop and use these pictures to determine the position or the movement of the camera with respect to such objects. The measured movements of the device are used for two purposes. One is for controlling different functions of the device using motion commands instead of, or in combination with, the operation of other input devices such as a keyboard. The second purpose is to control the information presented in the display of the device.

Additional mechanisms can be added to avoid unwanted changes in the information presented in the display, or unwanted activation of control functions, by small movements of the device, caused for example by small

instabilities of the hand holding the device. For example, it can be arranged that when the movements are small in terms of overall change in position, or when the speed or acceleration of the movement are below critical pre-defined values (that correspond to small unintended movement), such movements will be ignored and will not be used to change the information presented in the display or to activate control functions of the device.
These functions are further explained with reference to the drawings.

Figure. 1 shows a schematic diagram of a hand-held device such as a cellular telephone, and the notation used for describing directions of motion. The x and y directions are in the plane of the device and its display, and the z direction is perpendicular to this plane. Since the display is usually facing the user, the z direction is normally in a direction that brings the device closer to, or further away from, the user.

Figures 2, 3, 4 illustrate the use of the invention to control the presentation of information in the display of a hand-held device. Figure 2 is a schematic representation of a document 201 and a virtual window 202 which is a part of the document selected by the algorithm that controls the presentation of information in the device's display. This selected part is shown in the Figure as an outlined window placed over the document and selecting a part thereof. The document may contain text, graphics, still or moving pictures, and any combination thereof. The document or a large part of it is typically stored temporarily in a memory unit of the hand-held device. For example, the user may use a cellular phone to access information via the Internet. Information from the Internet will then be downloaded and stored temporarily in the device's memory. In this example the information contained in the entire document cannot be

all presented at once in the display of the hand-held device. Window 202 contains the portion of the document currently presented in the display of the hand-held device. The content of the window 202 is currently presented in the display 204 of the hand-held device 203. Figure 3 illustrates in a schematic form how the display of information from a document is controlled by moving the hand-held device. Device 303 and display 304 are the same as device 203 and display 204 in Figure 2. The device is now moved to a new position, in this example down and to the right in the Figure. Figure 303-A shows device 303 in its new position, following the movement, and 304-A shows the display in its new position, following the movement. This movement of the device is sensed by the elements that measure the acceleration, velocity or position of the device, and it is used to issue a command to change the information presented in the display 304-A. The change of information in the display will depend in general on the direction and magnitude of the movement of the device from its previous position to its new position, including in general both translation in space and rotational movements.

This is shown schematically by the movement of the window 302, corresponding to window 202 in Figure 2, to a new position 302-A over the document 301. The new information from the document corresponding to the part of the document within the new position of the window 302-A is now presented in the display 304-A. In this manner, physical movement of the band-held device in space corresponds to movements over the document showing at each time a part of the document, as if a real window was moved in a related manner over the document. The document 301can be scanned and different parts can be viewed by moving the hand-held device in space. The movement of the window over the document 301 can

correspond exactly to, be proportional to, or be related in other ways to the movement of the hand-held device. The rate of change of information in the display can be related to the speed or acceleration of the device itself, so that, for example, the document can be scanned faster by increasing the speed of movement of the hand-held device itself.

Figure 4 shows in a schematic form the use of movement to zoom in and out of the document. Moving the device in the z direction, for example in a direction closer to the viewer, will cause a zoom-in of the information presented in the display. For a text document, this will typically mean increasing the size of the viewed text, and at the same time decreasing the portion of the document presented in the display. For a picture image, zoom-in will increase the magnification of the presented image and will typically decrease the portion of the picture shown in the display. Movement in the opposite direction, along the z-axis but for example away from the viewer, will cause a zoom-put of the image. For a text image, this will typically mean reducing the front size in the displayed text, while showing at the same time a larger portion of text in the display. For a picture image, this zoom-out will decrease the magnification of the presented image, usually allowing the presentation of additional parts of a larger picture, but at a reduced magnification. The rate of change in magnification (rate of zoom-in or zoom-out) can be related to the speed or acceleration of the movement of the hand-held device, so that, for example, the rate of zoom can be increased by increasing the speed of motion of the device itself.

In Figure 4, a document 401 is shown. A selected part of this document shown as window 402 was presented in the display unit prior to a movement of the device in the

direction of the z-axis. The device was then moved along the x-axis, for example causing it to move closer to the eyes of the person holding the device. Figure 403 illustrates the device in its new position following the movement along the z-axis direction, and 404 is the display of device 403. The movement is measured and used to issue a command to change the information displayed in the display unit 404 of device 403. The information presented in the display unit 404 following the last movement of the device is shown schematically in window 402-A. This window is smaller than window 402. The information contained within this window will be displayed in the display 404 at a larger magnification than the presentation of this information prior to the movement of the device, and typically a smaller part of the document will be displayed at the increased magnification. In this manner, movements of the device along the z-axis direction cause zoom in and out of the information presented in the display of the hand-held device.

To avoid accidental activation of the device by movement that is not intended by the user to function as a command to the device or its display, the use of the movement to control the device or its display may be conditioned on the activation of an enabling switch. This is shown in Figure 5. The hand-held device is designated as 501; 502 the display of the device; and 503 is in this particular example a 3?position switch. Figure 504 shows a magnified view of the same 3?position switch. At one position of the switch 503 (shown also in 504) marked by N (for Neutral condition), the use of movements to control functions of the device or its display unit is disabled, and movements of the device will not be used to control the device or the information presented in its display. The same switch is used in

this example also to select between the control of device functions and control of its display. In position C (for 'Control') of switch 503 (shown also in 504), movements of the device are used to control different functions such as turning the device on or off. At this position, movements of the device will not be used to control the display. In position D (for 'Display') of the switch 503, shown also in 504, movements of the device are used to control the presentation of information in the display, as illustrated by examples in Figures 3 and 4. Switch 503 can be spring?loaded in such a way, that its natural position, in the lack of any external force, is the neutral position N. Positions C and D are achieved by pressing the switch against the spring.

Figure 6 shows a schematic block diagram of the apparatus described. In general, the apparatus contains elements for measuring the acceleration, velocity, or position of the hand?held device. In the example shown, the movement measurements are obtained by three accelerometers shown as 601?A, 601?B, 601?C in the drawing. The three accelerometers measure the acceleration of the device along three independent directions. Additional accelerometers can be used, for example for precise measurements of rotational movements of the device. The acceleration measurements are fed into a processor 602 in the drawing, that can be a special processor, or a processor such as a microprocessor that is used for other purposes in the hand?held device. The processor performs time integration of the acceleration measurements to obtain velocity measurements of the device, and also time integration of the velocity measurements to obtain measurements of the position of the device at any desired time. These integration functions can alternatively be performed by a dedicated processor connected to the

accelerometers rather then processor 602.

The processor 602 is connected to a display control unit 603 that controls the information presented in the display 604. The display control unit 603 is also connected to display buffer 605 that contains at any given time the information selected to be displayed in the display 604. The memory unit 606 is used to store a larger image, such as a full document or a part of it, and a selected part of the document stored in memory unit 606 is transferred to buffer 605 to be displayed in the display 604. The same memory 606 is also used to store recent movements of the device. This information can be used by the processor 602 to allow smooth update of the display over time, or for ignoring small movements of the device. The same memory unit 606 can also store other information such as recent commands issued by the user of the device.

The processor receives input also from control keys shown together as keyboard 607, that may include a control switch such as shown in Figure 5, switch 503, as well as other keys, control buttons, joystick and the like. Processor 602 uses the movements of the device together with information from control keyboard 607 to issue command signals to the display control unit 603, and to issue command signals to the device control unit 608, for example, for turning the device itself or different functions of the device on or off.

It is to be understood that the present invention is not limited to the embodiments described above, but encompass any and all embodiments within the scope of the following claims.

CLAIMS

1. A hand-held portable device comprising at least one movement measuring means capable of controlling one or more functions of the device.

2. A hand-held portable device comprising a display for information and at least one movement measuring means capable of controlling the information presented in the display of the device.

3. The hand-held portable device according to claim 1 or 2, wherein the movement measuring means senses the movement of the device or its position relative to another object.

4. The hand-held portable device according to claim 1 or 2, wherein the movement measuring means is an accelerometer.

5. The hand-held portable device according to claim 1 or 2, wherein the movement measuring means is a camera.

6. The hand-held portable device according to claim 1 or 2, wherein the movement measuring means is selected from the group consisting of an accelerometer, a camera and combinations of both.

7. The hand-held portable device according to claim 1 or 2, wherein the device is a remote control unit.

8. The hand-held portable device according to claim 1 or 2 further comprising a keyboard capable of controlling one or more functions of the device in combination with the measuring means.

9. The hand-held portable device according to claim 1 or 2 further comprising an enabling means for avoiding unwanted activation of the device.

10. A hand-held portable device comprising a display for presenting information and at least one movement measuring means capable of controlling one or more functions of the device and the presentation of information on the screen.

11. The hand-held portable device according to claim 10, wherein the movement measuring means senses the movement of the device or its position relative to another object.

12. The hand-held portable device according to claim 10, wherein the movement measuring means is an accelerometer.

13. The hand-held portable device according to claim 10, wherein the movement measuring means is a camera.

14. The hand-held portable device according to claim 10, wherein the movement measuring means is selected from the group consisting of an accelerometer, a camera and combinations of both.

15. The hand-held portable device according to claim 10, wherein the device is a remote control unit.

16. The hand-held portable device according to claim 10 further comprising a keyboard capable of controlling one or more functions of the device in combination with the measuring means.

17. The hand-held portable device according to claim 10 further comprising an enabling means for avoiding unwanted activation of the device.

18. A method for the kinematic control of a portable hand-held device comprising moving the hand-held device and measuring the movement of the device or its position relative to another object by one or more movement measuring means capable of controlling one or more functions of the device.

19. A method for the kinematic control of a portable hand-held device having a display for information comprising moving the hand-held device and measuring the movement of the device or its position relative to another object by one or more movement measuring means capable of controlling the presentation of information on the display.

20. A method for the kinematic control of a portable hand-held device having a display for information

comprising moving the hand-held device and measuring the movement of the device or its position relative to another object by one or more movement measuring means capable of controlling one or more functions of the device and the presentation of information on the screen.

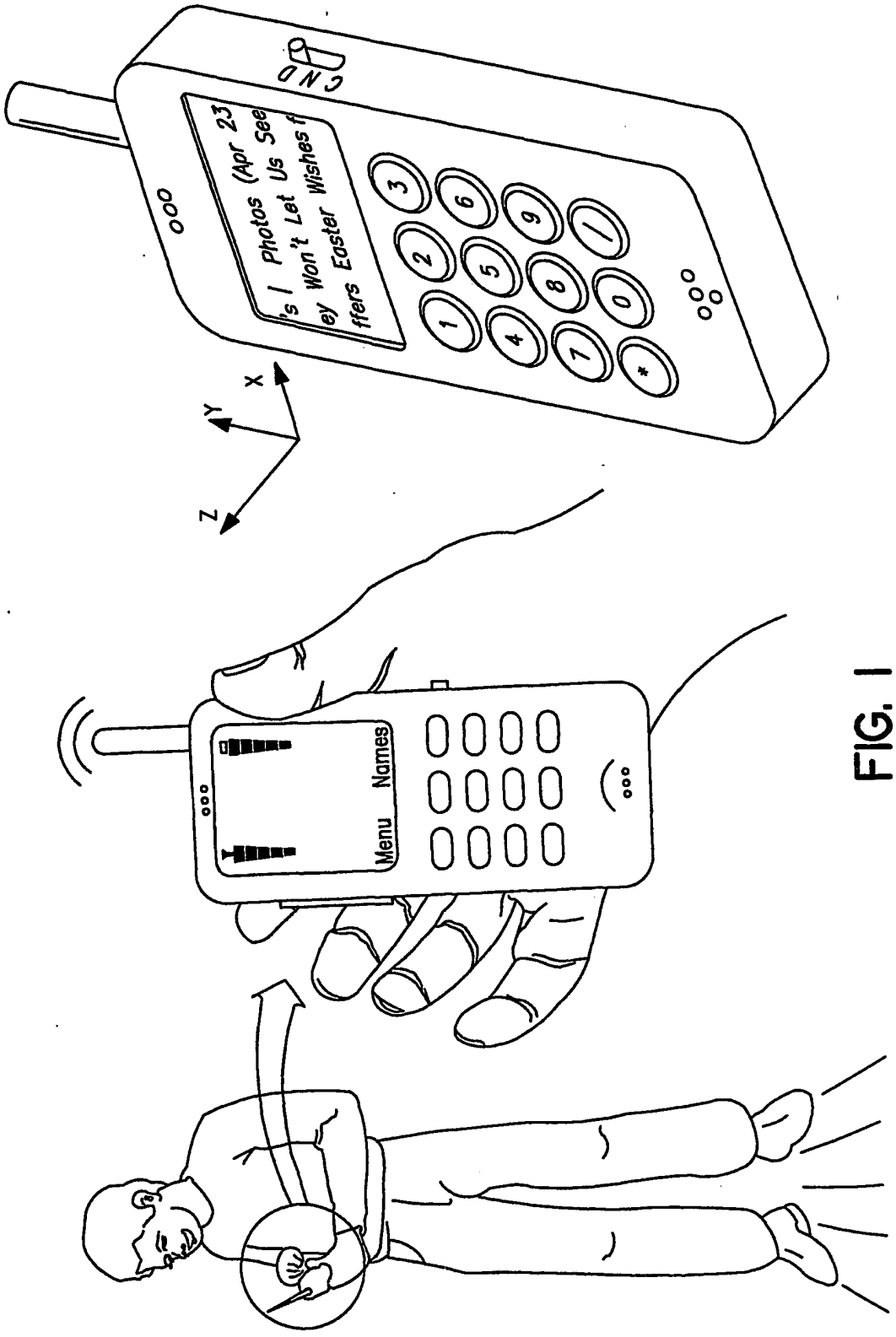
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FIG. 1

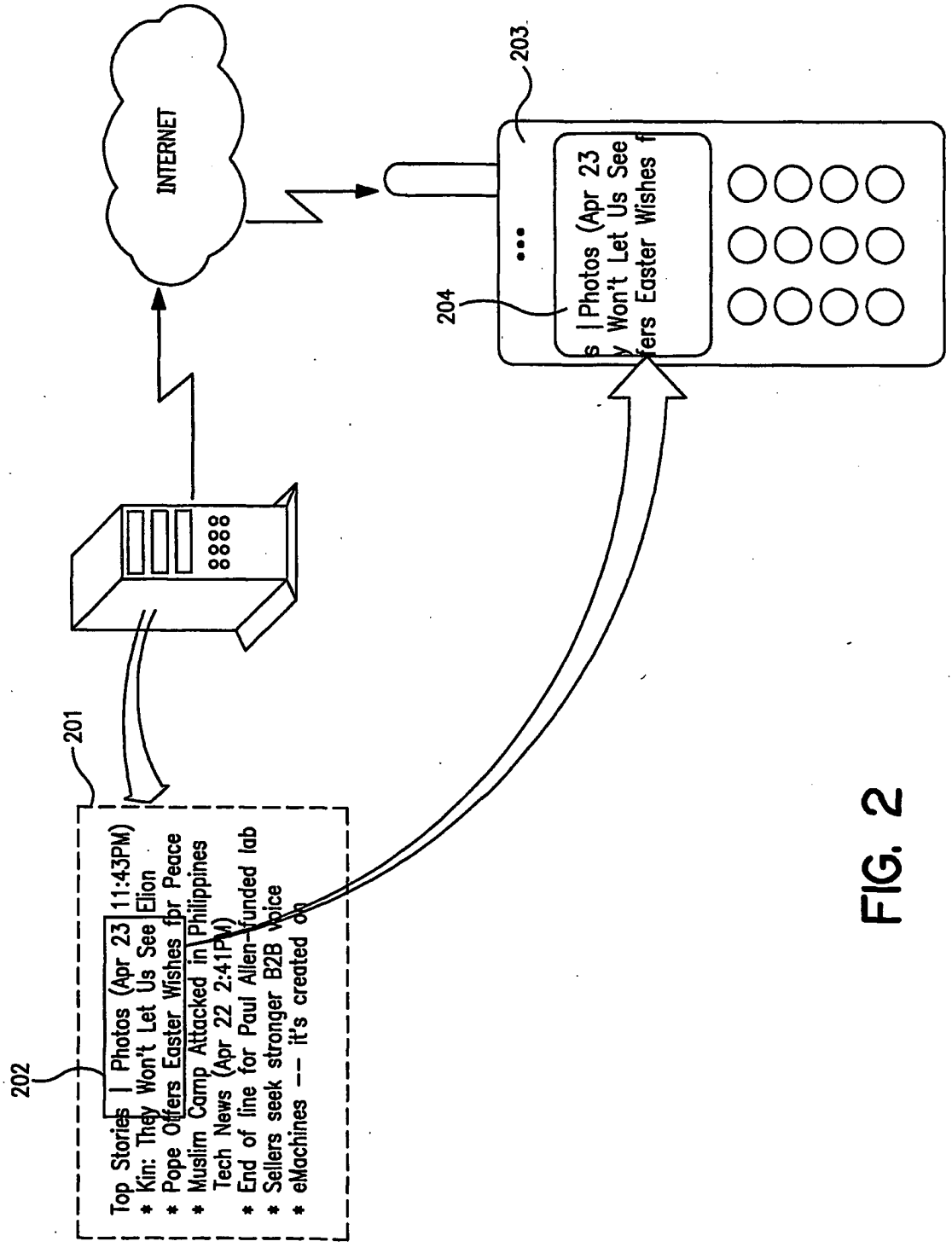
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FIG. 2

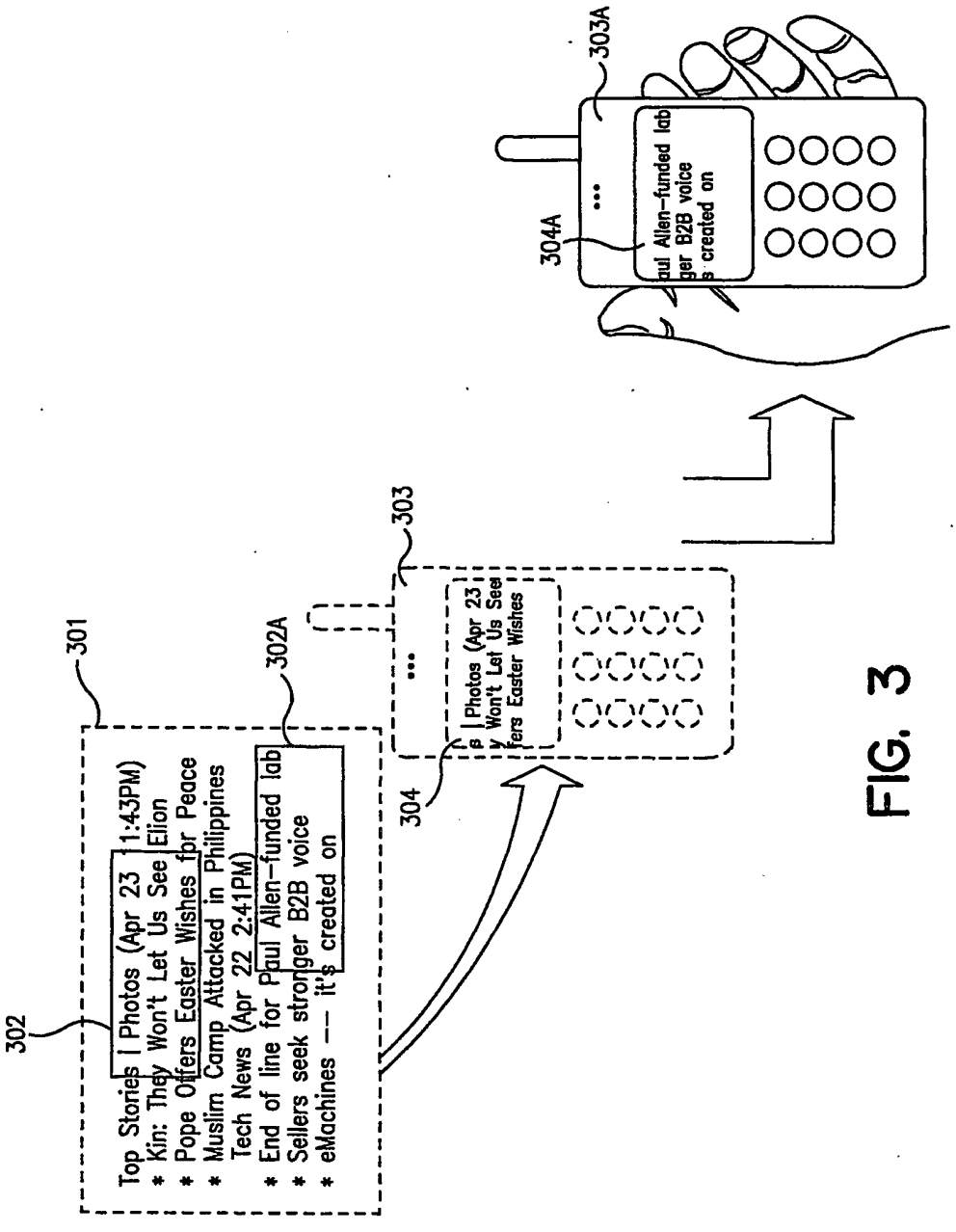
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FIG. 3

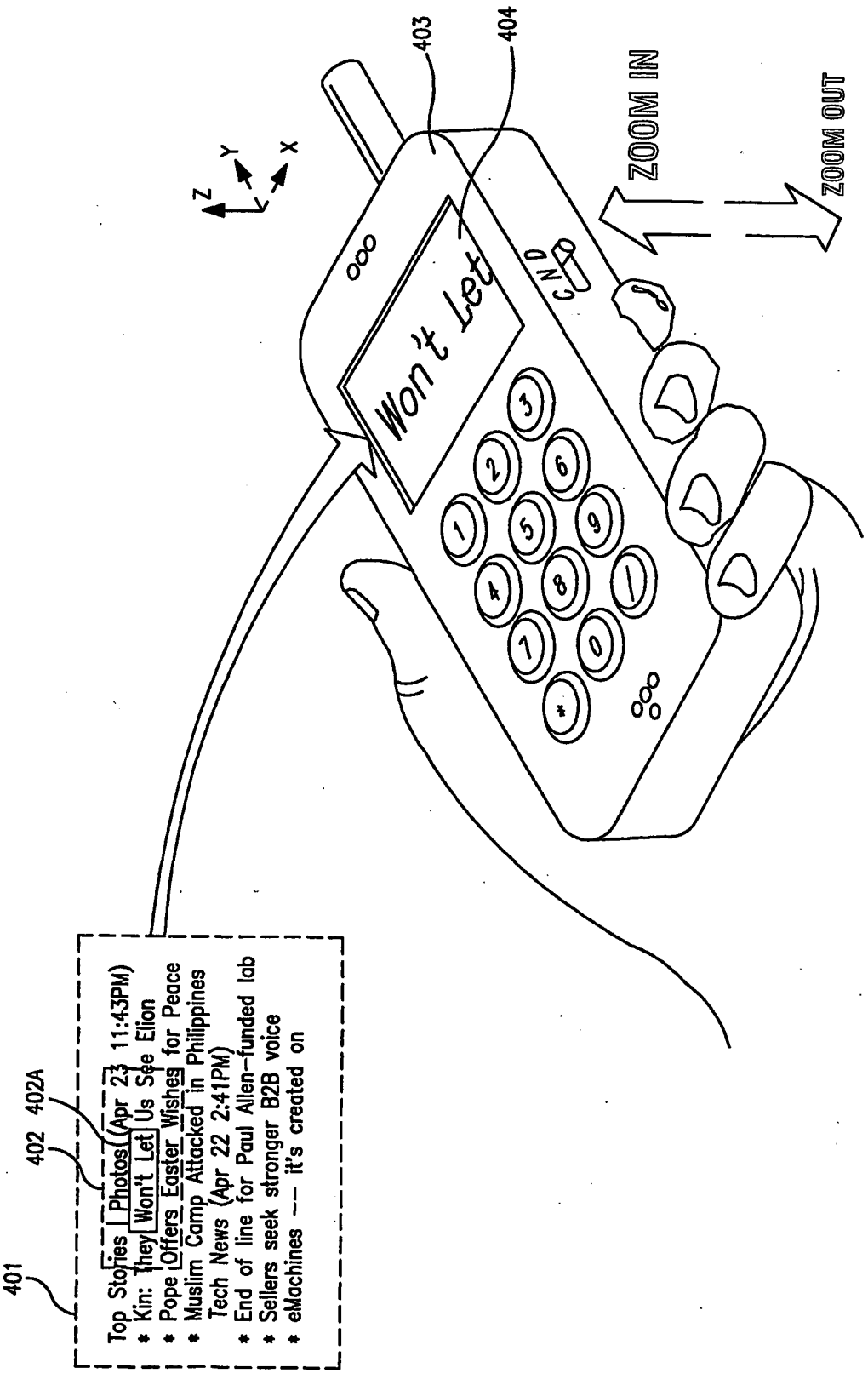
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FIG. 4

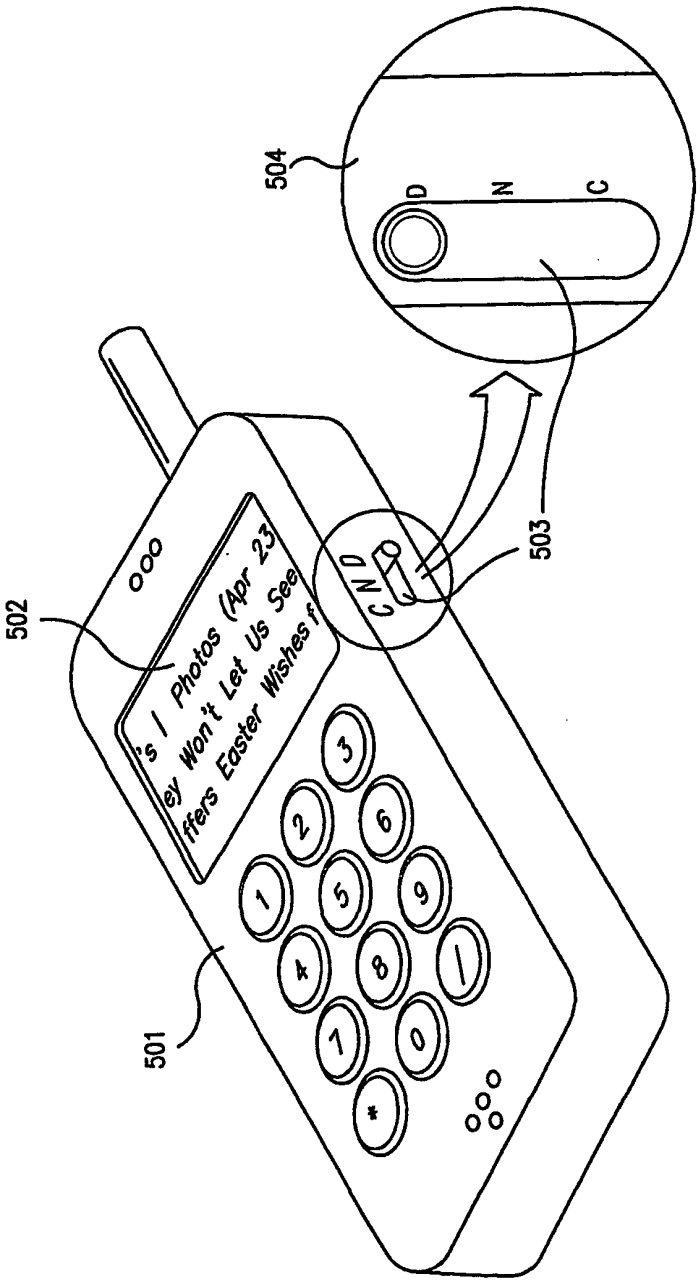
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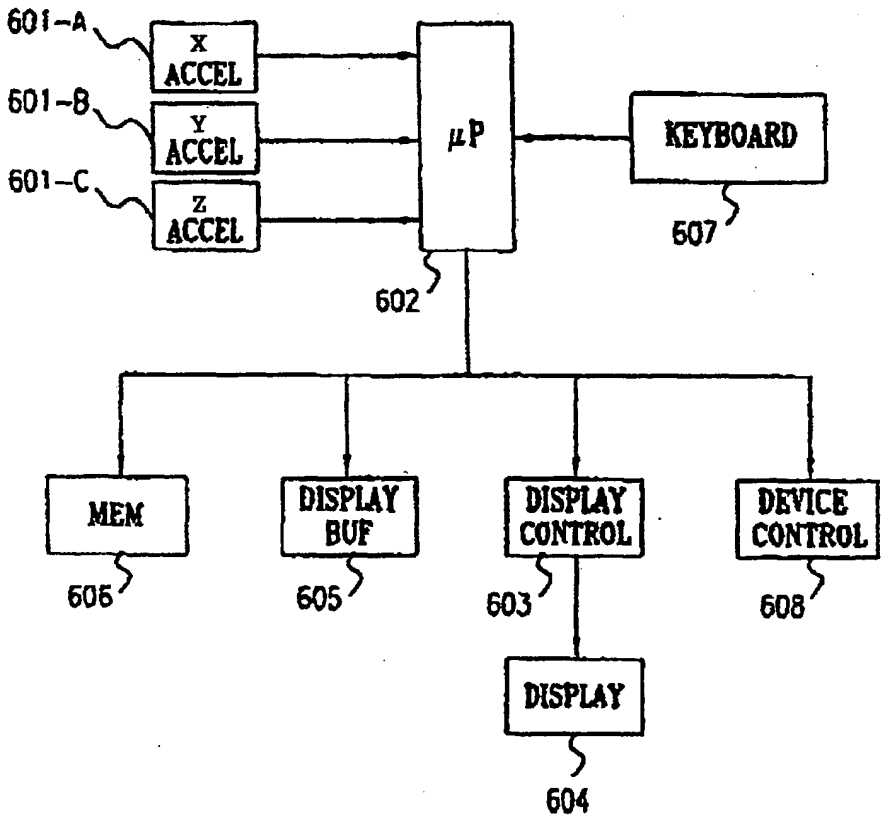
FIG. 5

FIG. 6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